SPECIAL PUBLICATION ARLCB-SP-84024

INDEX TO BENET WEAPONS LABORATORY (LCWSL) TECHNICAL REPORTS — 1983

R. D. NEIFELD

TECHNICAL PUBLICATIONS AND EDITING UNIT

JULY 1984

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT CENTER
LARGE CALIBER WEAPON SYSTEMS LABORATORY
BENÉT WEAPONS LABORATORY
WATERVLIET N.Y. 12189

DISCLAIMER

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

The use of trade name(s) and/or manufacture(s) does not constitute an official indorsement or approval.

DISPOSITION

Destroy this report when it is no longer needed. Do not return it to the originator.

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-SP-84024	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: INDEX TO BENET WEAPONS LABORATORY (LCWSL) TECHNICAL REPORTS - 1983	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): R. D. Neifeld	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Center, Benet Weapons Laboratory, DRSMC-LCB-TL, Watervliet, NY 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Center, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801	12. REPORT DATE: July 1984
	13. NUMBER OF PAGES: 117
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: UNCLASSIFIED
	15e. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Benet Weapons Laboratory
Technical Publications
Bibliography
Abstracts
Document Control Data

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This is a compilation of Benet Weapons Laboratory technical reports published during 1983.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

TABLE OF CONTENTS

TECHNICAL REPORTS 1983

REPORT NUMBER	TITLE	AUTHOR	DATE
ARLCB-MR-83001	Comparison of Launch Simulation and Fracture Toughness Test Results for M774 Depleted Uranium Penetrators	J.H. Underwood M.A. Scavullo	Jan 83
ARLCB-MR-83002	Effects of Curing Temperature and Time on Corrosion Resistance, Wear Life, Adhesion and Completeness of Cure of Sandstrom Solid Film Lubricant No. 9A	D. Trevett	Jan 83
ARLCB-TR-83003	Stress Intensity Factors for Radial Cracks in a Pre-Stressed, Thick-Walled Cylinder of Strain-Hardening Materials	S.L. Pu P.C.T. Chen	Feb 83
ARLCB-TR-83004	Fracture Damage and Failure of Cannon Components by Service Loading	J.H. Underwood	Feb 83
ARLCB-TR-83005	Thermo-Elastic-Plastic Analysis of a Thick-Walled Cylinder with Temperature-Dependent Yield Stress	P.C.T. Chen	Feb 83
ARLCB-TR-83006	A Generalized Rayleigh-Ritz Method for Structural Dynamics Problems in Conjunction with Finite Elements	J.J. Wu	Feb 83
ARLCB-TR-83007	Crack Initiation and Propagation in Metals in Liquid Mercury Using Fracture Mechanics	J.A. Kapp	Mar 83
ARLCB-TR-83008	Crack Growth in Mercury Embrittled Aluminum Alloys Under Cyclic and Static Loading Conditions	J.A. Kapp	Mar 83
ARLCB-TR-83009	Mechanical Properties of Hydrostatically Extruded Uranium - 0.75 Percent Titanium Alloy	C.J. Nolan M.H. Kamdar J.H. Underwood	Mar 83
ARLCB-TR-83010	Recent Findings and Developments in Chromium Plated Gun Tubes	V.P. Greco G. D'Andrea J. Walden	Mar 83
ARLCB-MR-83011	Material Handling	R.J. Meinhart	Apr 83
ARLCB-TR-83012	Gun Tube Extrusion	R.A. Farrara	Apr 83

REPORT NUMBER	TITLE	AUTHOR	DATE
ARLCB-SP-83013	Index to Benet Weapons Laboratory (LCWSL) Technical Reports - 1982	R.D. Neifeld	Apr 83
ARLCB-TR-83014	Recycling of Scrap Gun Tubes by Rotary Forging	C. Calderone	Apr 83
ARLCB-TR-83015	Rotary Forging of the M483A1 Projectile Body	L. Liuzzi	Apr 83
ARLCB-TR-83016	Evaluation of Superconducting Augmentation on a Rail Gun System	C.G. Homan W. Scholz	Jun 83
ARLCB-MR-83017	Improved Inspection Techniques for Ingots and Preforms for Rotary Forging	W. Sullivan V. Colangelo	May 83
ARLCB-MR-83018	Group Technology of Weapon Systems	J. Cocco	May 83
ARLCB-TR-83019	Engraving of Rotating Bands - A Modification of Metal-Flow Pattern	B. Avitzur	Jun 83
ARLCB-TR-83020	Results of the 105MM M68 Gun Tube Wear Survey 1981-82	B.J. Rowekamp	May 83
ARLCB-TR-83021	Large Caliber Powder Chamber Boring	A. Wakulenko	May 83
ARLCB-TR-83022	Metallographic Studies of Erosion and Thermo-Chemical Cracking of Cannon Tubes	R.M. Fisher A. Szirmae M.H. Kamdar	May 83
ARLCB-TR-83023	Elastic-Plastic Analysis of Annular Plate Problems Using NASTRAN	P.C.T. Chen	May 83
ARLCB-TR-83024	A Functional Stress Intensity Approach to Multiply Cracked, Partially Autofrettaged Cylinders	S.L. Pu	Jun 83
ARLCB-TR-83025	Erosion Control in Chromium Plated Cannon Tubes	R.S. Montgomery F.K. Sautter	Jun 83
ARLCB-TR-83026	Superconductivity in Hydrogen-Charged Ion-Beam Mixed Palladium Copper Alloy	W. Scholz A. Leiberich W.J. Standish C.G. Homan	Jun 83
ARLCB-TR-83027	Fatigue Behavior in Muzzle Region of Certain 105 MM M137A1 Howitzer Tubes	B.B. Brown	Jun 83

TECHNICAL REPORTS 1983 (CONT.)

REPORT NUMBER	TITLE	AUTHOR	DATE
ARLCB-TR-83028 (Rev.)	A Closure-Packing System to Minimize End Effects on Pressurized Cylinders	B.B. Brown	Jun 83
ARLCB-TR-83029	Studies of Refractory Metal Coatings for Advanced Gun Barrels	I. Ahmad J. Barranco P. Aalto J. Cox	Jul 83
ARLCB-TR-83030	Behavior of Pressurized Cylinders with Multiple Internal Cracks	J.F. Throop R. Fujczak	Sep 83
ARLCB-TR-83031	Evidence for the Melt-Lubrication of Projectile Bands	R.S. Montgomery	Sep 83
ARLCB-TR-83032	Electrical Transport in Low Resistivity Amorphous Alloys	L.V. Meisel P.J. Cote	Sep 83
ARLCB-TR-83033	Characterization of Crystallographic Structure and Internal Stress of Chromium Coatings Plated Under Current Interruptions	G.P. Capsimalis E.S. Chen	Sep 83
ARLCB-TR-83034	Sample Preparation and Evaluation of Steel Specimens for Inclusion Retention and Subsequent Automated Assessment	T.V. Brassard	Oct 83
ARLCB-MR-83035	Microstructural Analysis of a Rapidly Fired Five-Inch Navy Gun Tube	T.V. Brassard J.F. Throop	Oct 83
ARLCB-MR-83036	Cold Rotary Forging of a Thin-Walled Rifled Tube	B. Avitzur	Oct 83
ARLCB-TR-83037	Concept Study of Lightweight Large Caliber Weapons for Mobile Protected Gun System	R.H. Cole	Oct 83
ARLCB-TR-83038	Elastic Properties of Uranium - .78 Titanium as a Function of Pressure to 1.6 GPa	J. Frankel D. Dandekar	Oct 83
ARLCB-MR-83039	Determination of the Heat Treatment Characteristics of Various Gun Steels by Combined Thermomagnetic and Differential Thermal Analysis	P.J. Cote	Nov 83

TECHNICAL REPORTS 1983 (CONT.)

REPORT NUMBER	TITLE	AUTHOR	DATE
ARLCB-TR-83040	Fatigue Life Analysis and Tensile Overload Effects with High Strength Steel Notched Specimens	J.H. Underwood	Nov 83
ARLCB-TR-83041	Prediction of Residual Stresses in an Autofrettaged Thick-Walled Cylinder	P.C.T. Chen	Nov 83
ARLCB-TR-83042	Measurement of the Extent of Autofrettage in Tube Sections	B.B. Brown	Dec 83
ARLCB-TR-83043	Fracture Behavior of a Uranium and a Tungsten Alloy in a Notched Component with Inertia Loading	J.H. Underwood M.A. Scavullo	Dec 83
ARLCB-TR-83044	Magnetic Behavior of Pressure Quenched Cadmium Sulfide Containing Chlorine	P.J. Cote C.G. Homan W.C. Moffatt S. Block G.P. Piermarini R.K. MacCrone	Nov 83
ARLCB-TR-83045	Mechanical Properties of Silicone Rubber in a Closed Volume	G.P. O'Hara	Dec 83
ARLCB-MR-83046	Manufacture of Split Ring Breech Seals	R.S. DeMeo	Dec 83
ARLCB-TR-83047	Finite Element Results of Pressurized Thick Tubes Based on Two Elastic-Plastic Material Models	P.C.T. Chen G.P. O'Hara	Dec 83
ARLCB-TR-83048	Explicit Formulas for C^n Piecewise Hermite Basis Functions	R.W. Soanes, Jr.	Dec 83

AUTHOR INDEX--1983

SUBJECT INDEX--1983

AD NUMBERS--1983

REPORT NUMBER	AD NUMBER
ARLCB-MR-83001	B071 377L
ARLCB-MR-83002	A125 098
ARLCB-TR-83003	A125 552
ARLCB-TR-83004	A126 265
ARLCB-TR-83005	A127 447
ARLCB-TR-83006	A126 481
ARLCB-TR-83007	A129 555
ARLCB-TR-83008	A128 585
ARLCB-TR-83009	B073 291L
ARLCB-TR-83010	A129 905
ARLCB-MR-83011	A128 973
ARLCB-TR-83012	A131 896
ARLCB-SP-83013	A134 509
ARLCB-TR-83014	A130 921
ARLCB-TR-83015	B076 769L
ARLCB-TR-83016	A134 873
ARLCB-MR-83017	A132 949
ARLCB-MR-83018	A130 005
ARLCB-TR-83019	A131 662
ARLCB-TR-83020	B075 773L
ARLCB-TR-83021	B077 359L
ARLCB-TR-83022	A135 816
ARLCB-TR-83023	A131 293
ARLCB-TR-83024	A135 345

REPORT NUMBER	AD NUMBER
ARLCB-TR-83025	B076 768L
ARLCB-TR-83026	A134 910
ARLCB-TR-83027	B078 665L
ARLCB-TR-83028 (Rev.)	B080 168L
ARLCB-TR-83029	B077 771L
ARLCB-TR-83030	A136 104
ARLCB-TR-83031	A136 184
ARLCB-TR-83032	A136 331
ARLCB-TR-83033	A136 118
ARLCB-TR-83034	A136 147
ARLCB-MR-83035	B078 722L
ARLCB-MR-83036	A136 159
ARLCB-TR-83037	B078 999L
ARLCB-TR-83038	A136 156
ARLCB-MR-83039	B079 546L
ARLCB-TR-83040	A136 065
ARLCB-TR-83041	A136 133
ARLCB-TR-83042	B080 845L
ARLCB-TR-83043	A139 649
ARLCB-TR-83044	A141 447
ARLCB-TR-83045	A138 129
ARLCB-MR-83046	A138 553
ARLCB-TR-83047	A138 513
ARLCB-TR-83048	A139 806

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-83001	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* COMPARISON OF LAUNCH SIMULATION AND FRACTURE TOUGHNESS TEST RESULTS FOR M774 DEPLETED URANIUM PENETRATORS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. H. Underwood and M. A. Scavullo		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 4111.16.2991.6 PRON No. 1A1242221A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE January 1983 13. NUMBER OF PAGES 12
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution limited to US Government Agencies only because of test and evaluation; January 1983. Other requests for this document must be referred to Commander, ARRADCOM, ATTN: Benet Weapons Laboratory, DRDAR-LCB-RM, Watervliet Arsenal, Watervliet, NY 12189.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Service Simulation
Tensile Tests
Fracture
Failure

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Results are presented of launch simulation tests on depleted uranium long-rod penetrators. A correlation is shown to exist between plane-strain fracture toughness, K_{Ic}, and the energy to failure measured in the simulation tests. The launch survival of the penetrators is related to K_{Ic} and the energy to failure measured in the simulation test.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-MR-83002	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): Effects of Curing Temperature and Time on Corrosion Resistance, Wear Life, Adhesion and Completeness of Cure of Sandstrom Solid Film Lubricant No. 9A	5. TYPE OF REPORT & PERIOD COVERED: Final
6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s): DAVID TREVETT	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research and Development Command, Benet Weapons Laboratory, DRDAR-LCB-TL, Watervliet, N.Y. 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 3111.16.2223, DA Project. PRON No. WG-9-RN427M11A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research and Development Command, Large Caliber Weapon Systems Laboratory, Dover, New Jersey 07801	12. REPORT DATE: January 1983 13. NUMBER OF PAGES: 23
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Solid Film Lubricants
Corrosion resistance
Wear life
Accelerated tests

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The effect of curing temperature and time on a heat cured solid film lubricant (SFL) were investigated using accelerated corrosion and wear tests. Surface preparation and quality control inspections were also checked. Air cured SFL's were evaluated for corrosion resistance and wear life. A compromise between corrosion resistance and wear life must be made when selecting curing temperature and time for heat cured SFL. Air cured SFL's showed very poor corrosion resistance and wear life.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-TR-83003	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): STRESS INTENSITY FACTORS FOR RADIAL CRACKS IN A PRE-STRESSED, THICK-WALLED CYLINDER OF STRAIN-HARDENING MATERIALS	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): S. L. Pu and P. C. T. Chen	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Command, Benet Weapons Laboratory, DRDAR-LCB-TL, Watervliet, NY 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 611102H600011; DA Project No. 1L161102AH60; PRON No. 1A2250041A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Command, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801	12. REPORT DATE: February 1983
	13. NUMBER OF PAGES: 29
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

To be published in the Journal of Pressure Vessel Technology.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Stress Intensity
Pre-stressed Cylinders
Strain-Hardening Materials
Radial Checks

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A simple method which combines the weight function technique and finite element results is used to obtain mode I stress intensity factor solutions for radially cracked cylinders subjected to a high internal pressure. The method is especially effective for cylinders having residual stresses due to a manufacturing pre-stress process to increase the maximum pressure the cylinder can contain, and to improve the cylinder's useful life against fatigue and

(CONT'D ON REVERSE)

20. ABSTRACT (CONT'D)

fracture. The method is quite general for various assumptions involving the plastic stress-strain relations, the yield condition, the strain-hardening, and the compressibility of the cylinder material.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-TR-83004	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: FRACTURE DAMAGE AND FAILURE OF CANNON COMPONENTS BY SERVICE LOADING	5. TYPE OF REPORT & PERIOD COVERED: Final
6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s): J. H. Underwood	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Command, Benet Weapons Laboratory, DRDAR-LCB-TL, Watervliet, NY 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No.7280.12.1300.0 PRON NO.1A2270831A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Command, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801	12. REPORT DATE: February 1983 13. NUMBER OF PAGES: 24
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented at the 29th Sagamore U.S. Army Materials Research Conference, Lake Placid, NY, July 1982. To be published in the Proceedings of the 1982 Sagamore Conference.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Cannon
Fatigue Cracking
Residual Stress
Fracture Toughness

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The types of crack-related failure which occur as a result of cannon firing are reviewed. A very severe brittle fracture of an early cannon is resummarized. The failure processes typical of cannons are described, including crack initiation due primarily to high temperature exposure, fatigue crack growth due to the cyclic pressurization of firing, and final fast fracture through the wall of the cannon tube. The effects of chemical environment and residual stresses on the failure processes are discussed.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83005	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* THERMO-ELASTIC-PLASTIC ANALYSIS OF A THICK-WALLED CYLINDER WITH TEMPERATURE-DEPENDENT YIELD STRESS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) P. C. T. Chen		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 611102H600011 DA Project No. 1L161102AH60 PRON No. 1A2250041A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE February 1983 13. NUMBER OF PAGES 18
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented at 28th Conference of Army Mathematicians, Bethesda, Maryland, 28-30 June 1982.
Published in proceedings of the conference.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Thick-Walled Cylinder
Thermo-Elastic-Plastic
Temperature-Dependent Yield Stress
Numerical Approach
Non-isothermal

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A numerical approach based on the finite-difference method and incremental solution procedure has been developed for analyzing the thermo-elastic-plastic problem of a thick-walled cylinder with temperature-dependent yield stress. The cylinder is subjected to a combination of internal pressure and temperature variation. The material is assumed to obey the von Mises' yield criterion, the associated flow theory, and the isotropic hardening rule. Some numerical results for the displacements and stresses are presented.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83006	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* A GENERALIZED RAYLEIGH-RITZ METHOD FOR STRUCTURAL DYNAMICS PROBLEMS IN CONJUNCTION WITH FINITE ELEMENTS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Julian J. Wu		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.02.H600.011 PRON No. 1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE February 1983 13. NUMBER OF PAGES 18
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

To be presented at Third International Symposium on Numerical Methods for Engineering, Paris, France, 14-16 March 1983.
To be published in proceedings of the symposium.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Variational Method	Structural Dynamics
Finite Elements	Moving Loads
Numerical Methods	Stress Waves

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A solution formulation of generalized Rayleigh-Ritz method is described and applied to two initial and boundary value problems of stress waves and structural dynamics in conjunction with finite element discretization. Excellent numerical results have been obtained for wave equations associated with lateral and longitudinal vibrations and with strong discontinuities.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83007	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* CRACK INITIATION AND PROPAGATION IN METALS IN LIQUID MERCURY USING FRACTURE MECHANICS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. A. Kapp		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 61110191A0011 DA Project No. 1L161101A9A PRON No. 1A2231491A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE March 1983 13. NUMBER OF PAGES 33
14. MONITORING AGENCY NAME & ADDRESS*(If different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented at 1982 Fall AIME Meeting, St. Louis, MO, October 1982.
Published in proceedings of the meeting.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Fracture
Fatigue
Fracture Mechanics
Liquid Metal Embrittlement

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Fracture mechanics is a useful tool in the study of sub-critical crack growth. This report presents a summary of the results of several recent fracture mechanics studies of liquid metal embrittlement. Specific topics include crack growth measurements under cyclic loading conditions in 6061-T651 alloy embrittled by liquid mercury. The effect of mean stress on fatigue crack growth in a high strength-low alloy steel in mercury is discussed. Crack
(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (CONT'D)

growth studies under static loading conditions at various temperatures in both 6061-T651 aluminum and 70/30 alpha brass embrittled by mercury are also presented. Finally, some experiments on mercury wetted 70/30 alpha brass in Mode III loading (pure shear) are presented. The results are discussed in relation to transport mechanisms.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-TR-83008	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: CRACK GROWTH IN MERCURY EMBRITTLED ALUMINUM ALLOYS UNDER CYCLIC AND STATIC LOADING CONDITIONS	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Joseph A. Kapp	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Command, Benet Weapons Laboratory, DRDAR-LCB-TL, Watervliet, NY 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 61110191A0011, DA Project No. 1L161101A9A, PRON No. 1A2231491A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Command, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801	12. REPORT DATE: March 1983
	13. NUMBER OF PAGES: 173
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

This was a thesis in partial fulfillment of requirements for degree of Doctor of Philosophy in Materials Engineering at Rensselaer Polytechnic Institute, Troy, New York.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Fracture
Fatigue
Fracture Mechanics
Adsorption
Liquid Metal Embrittlement
Mercury
Aluminum

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Crack growth rates were measured on three aluminum alloys under cyclic and static loading conditions in laboratory air and in liquid mercury at about +25°C. One alloy, 6061-T651, was tested under both loading conditions at temperatures ranging from -25°C to +45°C. Fracture mechanics techniques were used.

(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (CONT'D)

Under cyclic loading conditions, no enhanced crack growth in mercury was measured until a critical stress intensity factor range (ΔK) was exceeded. When ΔK increased above the threshold value, the crack growth rate increased by as much as three orders of magnitude, when compared to the crack growth rate in air. From the appearance of the fracture surface the mechanism of embrittlement was deduced to be reduced cohesion.

Under static loading conditions, crack velocities of centimeters per second were measured in load control. Under displacement control much slower crack velocities were measured in two alloys. The decrease in crack velocity was attributed to crack blunting and large plastic zones. Static crack velocity and cyclic crack growth rate increased with decreasing temperature. This unusual temperature effect was related to the kinetics of adsorption of mercury on aluminum.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83009	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* MECHANICAL PROPERTIES OF HYDROSTATICALLY EXTRUDED URANIUM - 0.75 PERCENT TITANIUM ALLOY		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) C. J. Nolan, M. H. Kamdar, and J. H. Underwood		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 611102H600011 DA Project No. 1L161102AH60 PRON No. 1A2250041A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE March 1983 13. NUMBER OF PAGES 26
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution limited to US Government Agencies only because of test and evaluation; March 1983. Other requests for this document must be referred to Commander, ARRADCOM, ATTN: Benet Weapons Laboratory, DRDAR-LCB-RM, Watervliet Arsenal, Watervliet, NY 12189.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Extrusion
Uranium
Toughness
High Pressure

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A study has been undertaken to improve the notch sensitivity and brittleness of uranium 0.25 wt. % titanium penetrator alloy. Hydrostatic extrusion processing has been utilized to extrude uranium alloys without cracks at room temperature up to 50 percent reduction in as received, solution treated, solution treated and aged, and homogenized conditions. The extruded billets were tested to determine the effects of percent reduction and heat treatment on the mechanical
(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (Cont'd)

properties, specifically strength, tensile ductility, and fracture toughness. The as received and the solution treated conditions when extruded to 50 percent reduction, showed 50 percent increase in strength. The as received alloy showed little increase in fracture toughness, while the solution treated alloy showed about 20 percent increase in fracture toughness. The results suggest that improved properties can be obtained via solution heat treatments.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83010	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) RECENT FINDINGS AND DEVELOPMENTS IN CHROMIUM PLATED GUN TUBES		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) V. P. Greco, G. D'Andrea, and J. Walden		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3297.06.8243 PRON No. 1A1282411A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE March 1983 13. NUMBER OF PAGES 22
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Presented at Tri-Service Symposium on Gun Tube Wear and Erosion, Dover, NJ, 25-28 October 1982.
Published in proceedings of the symposium.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Rifling Profile
Chromium Plated Bores
Bore Wear

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The shortcomings encountered with conventional high contraction chromium coatings in gun bores during past investigations are reviewed. Changes in the application of chromium for improving its performance during firing are proposed. Recent developments on the application of low contraction chromium with a new plating process, effects of partially plated bores on accuracy, and the effects of rifling profile on the wear of chromium coatings are discussed.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-83011	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Material Handling		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Robert J. Meinhart		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research and Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, N.Y. 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3297.06.8208 DA Project. PRON No. M1-0-P1640-M1-1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon System Laboratory Dover, New Jersey 07801		12. REPORT DATE April 1983 13. NUMBER OF PAGES 48
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Originally prepared as an MM&T project report in May 1981, and submitted to U.S. Army Armament Materiel Readiness Command.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Material Handling
Overhead cranes
Sideloading lift trucks
Automatic guided vehicle

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Current material handling problems encountered during the manufacturing of gun tubes are discussed. Solutions recommended by a private contractor are presented. These solutions are (1) use masted cranes, (2) use sideloading lift trucks, and (3) use an automatic guided vehicle system with sideloading lift trucks. Installation costs and return-on-investment are detailed.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83012	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Gun Tube Extrusion		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) R. A. Farrara		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research and Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, N.Y. 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3111151100 DA Project. PRON No.32-9-P5299M71A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE April 1983 13. NUMBER OF PAGES 22
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Extrusions
Gun Tubes
Gun steel - AOD Process

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Hollow, two diameter, thick walled cylinders were produced via the hot extrusion process by the Curtiss-Wright Corp., Buffalo, New York. The material was gun steel (4335V modified) produced by Electralloy Corp., Oil City, PA, in an argon-oxygen decarburization (AOD) vessel. The extrusions were heat treated to develop mechanical properties required for the 105mm M68 gun tube per the Specification MIL-S-46119. Mechanical properties (tension, charpy V-notch and fracture toughness specimens) were measured

20. ABSTRACT (cont'd)

in the transverse and longitudinal directions along the length of three (3) extrusions. The macrostructure and microstructure were also examined. The mechanical properties were satisfactory; however, the charpy V-notch impact energy was marginal. The dimensions, straightness, and wall thickness variations were consistent and met the requirements. Although more material had to be removed, compared to conventional forgings, the total time for machining an extrusion would not be more than for conventional forgings because they are easier to straighten and set up than the normal tapered forgings.

SECURITY CLASSIFICATION OF THIS PAGE *(When Date Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-SP-83013	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* INDEX TO BENET WEAPONS LABORATORY (LCWSL) TECHNICAL REPORTS - 1982		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) R. D. Neifeld		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE April 1983 13. NUMBER OF PAGES 101
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Benet Weapons Laboratory
Technical Publications
Bibliography
Abstracts
Document Control Data

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This is a compilation of Benet Weapons Laboratory technical reports published during 1982.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Date Entered)*

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83014	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Recycling of Scrap Gun Tubes by Rotary Forging		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Charles Calderone		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research and Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, N.Y. 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3297.06.7727 PRON No. M1-9-P1589-M1-1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE April 1983 13. NUMBER OF PAGES 33
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Originally submitted as an MM&T project to the U.S. Army Armament Materiel Readiness Command in September 1981.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Rotary Forge	Intermediate Preform
Recycling	Vacuum Degassing (VD)
Scrap tubes	Vacuum Deoxidizing (VDox)
Fired-out	Electroslag Refining (ESR)
Preform	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Recycling of gun tubes has been a two-year MM&T effort by the Advanced Engineering Section of Benet Weapons Lab at Watervliet Arsenal. The basic approach involves rotary forging of scrap (fired-out, mismachined, obsolete, etc.) tubes directly into a new tube forging of smaller size without any intermediate melting operation.

The preliminary phase or first year's effort of this project determined the quantities of scrap tubes available for recycling and future tube production

cont'd.

requirements. This phase was then followed by processing a sample quantity of scrap tubes from the field. Since tubes with the largest volume of material showed the most potential for recycling, emphasis was placed on locating larger tubes; namely, 8" M2A2 and 175mm M113 gun tubes. Other tube models, such as the 155mm M185, were also included in the study. The samples of selected tubes were then inspected for the extent of damage. Based on the firing damage, a standard machining procedure was established to prepare a tube for recycling.

A computer program was then developed which, based on tube dimensions, generates an optimum mix of new tubes that can be produced giving the required preform dimensions. Based on this computer program, scrap tubes were cut and recycled through the Rotary Forge.

The overall results proved that scrap tubes can be made into acceptable forgings that meet the dimensional drawing requirements. The follow-up heat treatment and mechanical property testing resulted in less than half of the tubes meeting the required mechanical properties. However, in analyzing these results, the older scrap tubes produced by air melting practices, resulted in very few with acceptable mechanical properties. The scrap tubes of a more recent vintage originally produced from newer melting practices such as, vacuum degassing, vacuum deoxidizing, and electroslag refining resulted in nearly 100% with acceptable mechanical properties.

The recycling program will result in substantial cost savings when applied to scrap tubes originally produced from the newer melting practices.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83015	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Rotary Forging of the M483A1 Projectile Body		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Leonard Liuzzi		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research and Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, N.Y. 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 49500566810 DA Project. PRON No. 81826748GGM7
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE April 1983 13. NUMBER OF PAGES 42
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Distribution limited to U.S. Government agencies only because of test and evaluation; April 1983. Other requests for this document must be referred to Cdr., ARRADCOM,ATTN:Benet weapons Laboratory, DRDAR-LCB-SE, Watervliet,N.Y. 12189.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Rotary Forge
Projectile Body Forging
Forging, Steel

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The rotary forge process has been used for the production of cannon tube forgings since 1978. To form the bore, a stub (partial length) mandrel is used. To form the internal diameter of a closed cylinder, a full length mandrel must be employed. This presents some questions regarding the viability of the process.

Continued on back

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

20. ABSTRACT:

As part of a project to maximize productivity in the production of 155mm M483A1 projectile bodies, the rotary forge process was evaluated. Since the projectile body was to be forged as a closed cylinder, a full length mandrel had to be employed. Trial forgings were produced on a GFM machine in Steyr, Austria, on preforms produced by Chamberlain Manufacturing Corp. Several types of preforms were evaluated, including as-forged and machined. It was determined that the projectile body can be rotary forged with a reduction in weight compared to standard forging techniques. However, because of the commitment to equipment already made at the several ammunition plants, a significant economic benefit can be realized only under full mobilization production conditions.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83016	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* EVALUATION OF SUPERCONDUCTING AUGMENTATION ON A RAIL GUN SYSTEM		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) C. G. Homan and W. Scholz		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.02.H600.011 Pron No. 1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE June 1983
		13. NUMBER OF PAGES 24
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented at 4th International Pulsed Power Conference,Albuquerque,NM. June 1983.Published in proceedings of the Second Symposium on Electromagnetic Launch Technology

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Rail Gun
Normally Conducting Augmentation
Superconducting Augmentation
System Comparison
Launch Efficiency
Constant Rail Current
Variable Rail Current

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The simple rail gun and rail guns with normally conducting and superconducting augmentation are discussed using an energy approach. Ideal launch efficiencies neglecting Joule losses and assuming constant rail current during the launch are shown to be 50 percent for normally conducting systems, and up to 100 percent for systems with superconducting augmentation. Energy requirements of an actual system are compared with expected values for a system with superconducting augmentation. The situation of variable rail currents has also been discussed.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-83017	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Improved Inspection Techniques for Ingots and Preforms for Rotary Forging		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) William Sullivan Vito Colangelo		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research and Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, N.Y. 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3297.06.8048 DA Project. PRON No. M1-8-P1890-M1-1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE May 1983 13. NUMBER OF PAGES 13
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

18. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Originally submitted as an MM&T project to the U.S. Army Armament Material Readiness Command.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Ultrasonic Inspection
ESR Ingot Inspection
Non-Destructive Testing

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report outlines the work conducted in developing a semi-automatic production inspection facility for the inspection of ingots and preforms prior to hot forging. The details of the system including descriptions, procedures and drawings are available as a Technical Date Package from Watervliet Arsenal, Watervliet, N. Y.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-83018	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* GROUP TECHNOLOGY OF WEAPON SYSTEMS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. Cocco		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3297.06.7724 PRON No. M1-9-P1594-M1-1A
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE May 1983 13. NUMBER OF PAGES 11
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Originally submitted as an MM&T project to the U.S. Army Armament Materiel Readiness Command in September 1982.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Group Technology	Part Families
MICLASS	Rotational Parts
Manufacturing Cells	Standard Process Planning
Part Coding	Automation

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Group technology provides a method of classifying manufactured parts such that pertinent information concerning the parts is retained in the assigned code number. This study investigated the effect a group technology system would have upon the manufacturing of parts used in armaments. Conclusions drawn indicate a potential productivity improvement could be realized if group technology were employed.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83019	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ENGRAVING OF ROTATING BANDS - A MODIFICATION OF METAL-FLOW PATTERN		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Dr. Boaz Avitzur		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.02.H600.011 PRON No. 1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE June 1983 13. NUMBER OF PAGES 30
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Presented at Tri-Service Symposium on Gun Tube Wear and Erosion,
Dover, NJ, 25-28 October 1982.
Published in proceedings of the symposium.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Rotating Bands
Engraving
Commencement-of-Rifling

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An evaluation of the commencement-of-rifling (C.O.R.) geometry suggests that the mode of deformation of the rotating band by the rifling is inefficient. Observation of rotating bands of fired and retrieved projectiles confirms the above evaluation. Engravers, simulating the conventional design of C.O.R. as well as the proposed modification, were fabricated. Slugs of rotating band material were engraved with the simulated engravers. Metallographic data on
(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

20. ABSTRACT (CONT'D)

the laboratory engraved slugs were compared with those of retrieved projectiles; results from the two simulating designs were also compared. Similarities were found between retrieved bands and simulated conventional design, while the simulated modification resulted in change in metal-flow pattern close to the intended one. Reduced engraving forces were observed as predicted and can be explained by reduced deformation forces when the modified design of C.O.R. is being simulated. It is suggested that reduced deformation forces will reduce wear at the commencement-of-rifling.

SECURITY CLASSIFICATION OF THIS PAGE (When Date Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83020	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) RESULTS OF THE 105MM M68 GUN TUBE WEAR SURVEY 1981-82		5. TYPE OF REPORT & PERIOD COVERED Final-1981-82 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) B. J. ROWEKAMP		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, NY 12189 DRDAR-LCB-DP		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 41111629780 DA Project. PRON No. M18GG063M11A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE May 1983 13. NUMBER OF PAGES 59
14. MONITORING AGENCY NAME & ADDRESS(If different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Distribution limited to U.S. Government agencies only (Test and Evaluation April 1983). Other requests for this document must be referred to Commander, ARRADCOM, ATTN: Benet Weapons Laboratory, DRDAR-LCB-DP, Watervliet, NY 12189.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Primary Wear
Secondary Wear
Primary Land Wear
Secondary Groove Wear
Secondary Land Wear
Stargage
Pullover Gage
Borescope

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This presents the background, procedures, results and conclusions of the 105mm M68 Gun Tube (M60/M-1 Tank) Wear Survey. The survey measured and recorded tube wear on a sample basis of gun tubes in Army units stationed in the U.S., Germany and the National Guard.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Date Entered)

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83021	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* LARGE CALIBER POWDER CHAMBER BORING		5. TYPE OF REPORT & PERIOD COVERED Final Technical Report Jan 80 - Sep 82 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Alex Wakulenko		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3297.06.8106 PRON No. M1-0-P1639-M1-1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE May 1983 13. NUMBER OF PAGES 65
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution limited to US Government Agencies only because of proprietary information; May 1983. Other requests for this document must be referred to Commander, ARRADCOM, ATTN: Benet Weapons Laboratory, DRDAR-LCB-SE, Watervliet Arsenal, Watervliet, NY 12189.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Originally submitted as an MM&T project to the U.S. Army Armament Materiel Readiness Command in September 1982.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Large Caliber Powder Chamber Boring
Balanced Tool Boring
Contour Boring

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report is the first phase of a project established to improve the current powder chamber contour boring operation to eliminate a semifinish grinding requirement. The first part consisted of the engineering and design efforts conducted to arrive at the optimum cutting system.

The results are a design of a balanced cutting force Boring Bar System employing two diametrically opposed cutting tools which are independently

(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (CONT'D)

positioned by two internal cam and slide assemblies. Also, a specification was prepared to purchase a Precision Positioning System which will provide programmable tool positioning and control to the Boring Bar System. Together these two systems will form a Computer Numerical Control (CNC) operated contour boring unit which can produce powder chambers in 155mm cannon tubes.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-TR-83022	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: METALLOGRAPHIC STUDIES OF EROSION AND THERMO-CHEMICAL CRACKING OF CANNON TUBES	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): R. M. Fisher*, A. Szirmae*, and M. H. Kamdar *Cont'd on Reverse	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Command, Benet Weapons Laboratory, DRDAR-LCB-TL, Watervliet, NY 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No.691000H840021; PRON No.182279141A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Command, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801	12. REPORT DATE: May 1983
	13. NUMBER OF PAGES: 16
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented at the Tri-Service Gun Tube Wear and Erosion Symposium, ARRADCOM, Dover, NJ, October 1982 and published in the Proceedings.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Guns
Erosion
Thermo-Chemical
Cracking

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The characteristic erosion features of fired cannons and the closely related surface alterations on laboratory simulation samples have been examined with a variety of electron optical and other analytical techniques. The results suggest that the heat-checking pattern is caused by the large differential thermal contraction between surface austenite and subsurface tempered martensite, the deep longitudinal cracks result from liquid-solid metal
(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

7. AUTHOR(S)

R. M. Fisher and A. Szirmae
U.S. Steel Corporation
Research Laboratory
Monroeville, PA 15146

20. ABSTRACT

embrittlement primarily by copper, and the subsurface microstructural alterations are a consequence of intense carburization by the explosion gases. The observations could provide the basis for thermomechanical modeling of the erosion and cracking of cannon tubes.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83023	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* ELASTIC-PLASTIC ANALYSIS OF ANNULAR PLATE PROBLEMS USING NASTRAN		5. TYPE OF REPORT & PERIOD COVERED FINAL 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) P. C. T. Chen		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No6111.02.H600.011 PRON No.1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE May 1983 13. NUMBER OF PAGES 18
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented at the 11th NASTRAN Users' Colloquium, San Francisco, CA, 5-6 May 1982.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

NASTRAN Program
Finite Elements
Annular Plate
Plastic Deformation

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The plate elements of the NASTRAN code are used to analyze two annular plate problems loaded beyond the elastic limit. The first problem is an elastic-plastic annular plate loaded externally by two concentrated forces. The second problem is stressed radially by uniform internal pressure for which an exact analytical solution is available. A comparison of the two approaches together with an assessment of the NASTRAN code is given.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-TR-83024	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: A FUNCTIONAL STRESS INTENSITY APPROACH TO MULTIPLY CRACKED, PARTIALLY AUTOFRETTAGED CYLINDERS	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): S. L. Pu	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Command, Benet Weapons Laboratory, DRDAR-LCB-TL, Watervliet, NY 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 611102H600011, DA Project No. 1L161102AH60, PRON No. 1A2250041A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Command, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801	12. REPORT DATE: June 1983
	13. NUMBER OF PAGES: 28
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented at 28th Conference of Army Mathematicians, Bethesda, Maryland, 28-30 June 1982.
Published in proceedings of the conference.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Multiple Cracks	Residual Stresses
Thick-Wall Cylinder	Finite Elements
Stress Intensity Factors	Weight Functions

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The functional stress intensity approach is presented for a partially auto-frettaged, thick-walled cylinder. This approach is a combination of a series of methods developed for the computation of stress intensity factors for multiple-radial cracks emanating from the inner or the outer surface of a hollow cylinder. The numerical method is mainly based on the finite element method using 12-node quadrilateral, isoparametric elements with singular
(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (Cont'd)

elements around a crack tip. The difficulty due to the presence of initial stresses in the finite element method is obviated by the method of thermal simulation which replaces the residual stresses existing in an autofrettaged cylinder by an active thermal load. The weight function method is incorporated to reduce the repeated computations of stress intensity factors of the same geometrical configuration subjected to various external loads and residual stresses. The functional stress intensity factor is introduced to overcome the difficulty in seeking the weight function itself.

Numerical results of functional stress intensity factors are given for multiple cracks radiating from the bore or from the outer surface of a cylinder having an external diameter twice that of an internal diameter. A linear superposition of these results gives the resultant stress intensity factor of a cracked geometry subjected to combined external loads and initial stresses. It is highly possible to extend the method outlined in this report for elastic-perfectly plastic material to strain-hardening materials.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83025	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* EROSION CONTROL IN CHROMIUM PLATED CANNON TUBES		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) R. S. Montgomery and F. K. Sautter		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.02.H600.011 PRON No. 1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE June 1983 13. NUMBER OF PAGES 14
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution limited to US Government Agencies only because of test and evaluation; June 1983. Other requests for this document must be referred to Commander, ARRADCOM, ATTN: Benet Weapons Laboratory, DRDAR-LCB-RP, Watervliet Arsenal, Watervliet, NY 12189.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Erosion	Spalling	Plastic Rotating Bands
Chromium Plating	Duplex Coatings	Traction Stresses
Cannon Bores	Dispersion Hardening	Nitriding
Stresses	Engraving Stresses	Sandblasting
Residual Stresses	Pre-engraved Rotating Bands	Autofrettaging

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The chief cause of erosion in chromium plated cannon bores is mechanical stresses. Chromium is chemically inert to the propellant gases and does not melt at the bore temperature. Erosion can be controlled in chromium plated cannon tubes by lowering the stresses on the plate, by decreasing the effect of the stresses, or by both of these used in conjunction.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-TR-83026	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): SUPERCONDUCTIVITY IN HYDROGEN-CHARGED ION-BEAM MIXED PALLADIUM COPPER ALLOY	5. TYPE OF REPORT & PERIOD COVERED
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): W. Scholz*, A. Leiberich*, W. J. Standish*, and C. G. Homan	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Command, Benet Weapons Laboratory, DRDAR-LCB-TL, Watervliet, NY 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS N0.6111.02.H600.011, D.A.Proj.1L161102AH60, PRON No. 1A2250041A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Command, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801	12. REPORT DATE: June 1983
	13. NUMBER OF PAGES: 13
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Presented at the International Conference on Ion Beam Modification of Materials, Grenoble, France, 6-10 September 1982.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Superconductivity
Palladium Copper Hydride
Ion-Beam Mixed Alloy
Transition Temperature

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Superconducting $Pd_xCu_{1-x}(H)$ has been made by ion-beam mixing and low-temperature electrolysis. A multi-layered sample consisting of alternate layers of Cu and Pd, sputter-deposited onto a Pd foil substrate, was bombarded with 125 KeV Xe^+ ions. Analysis by Rutherford backscattering (RBS) showed the formation of a $Pd_{.6}Cu_{.4}$ alloy region approximately 38 $\mu g/cm^2$ thick. After electrolytic charging with H at dry ice temperature, superconductivity was

(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

7. AUTHOR(S) (CONT'D)

*W. Scholz, A. Leiberich, and W. J. Standish
State University of New York at Albany
Albany, NY 12222

20. ABSTRACT (CONT'D)

observed, with a transition temperature, T_c, of 11.4 K in the alloy region. The effects of increased currents and changes in the H distribution due to annealing between 77 K and 85°C on the transition curves have been investigated. Transition curves produced in this fashion are broad with an onset of the superconducting transition as high as 14 K. The sample remains partially superconducting even after overnight anneal at room temperature. Electrolysis at room temperature also produces superconducting transitions with onsets as high as 17 K.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83027	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* FATIGUE BEHAVIOR IN MUZZLE REGION OF CERTAIN 105 MM M137A1 HOWITZER TUBES		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Bruce B. Brown		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Command Benet Weapons Laboratory, DRDAR-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 738017.I00Q1 PRON No. 1A2265691A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE June 1983 13. NUMBER OF PAGES 46
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution limited to US Government Agencies only because of test and evaluation; June 1983. Other requests for this document must be referred to Commander, ARRADCOM, ATTN: Benet Weapons Laboratory, DRDAR-LCB-RM, Watervliet Arsenal, Watervliet, NY 12189.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Howitzer
105 mm M137A1
Muzzle
Fatigue
Residual Stress
Fracture Toughness
Safe Service Life

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Six 105 mm M137A1 howitzers were subjected to hydraulic fatigue testing and analysis to better define a recently discovered muzzle end crack problem. Four of the specimens contained abnormal initial cracking and displayed short fatigue lives. Two specimens with far fewer rounds fired did not have this abnormal initial cracking and gave greater laboratory fatigue lives. Analysis showed low residual stress at the failure region of all six samples. Safe life reliability results are shown for several analytical approaches.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-TR-83028 (Rev.)	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: A CLOSURE-PACKING SYSTEM TO MINIMIZE END EFFECTS ON PRESSURIZED CYLINDERS	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Bruce B. Brown	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Command, Benet Weapons Laboratory, DRDAR-LCB-TL, Watervliet, NY 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 69100R.40800.21, PRON No. 1A325F161A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Command, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801	12. REPORT DATE: June 1983
	13. NUMBER OF PAGES: 21
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution limited to US Government Agencies only because of test and evaluation; June 1983. Other requests for this document must be referred to Commander, ARRADCOM, ATTN: Benet Weapons Laboratory, DRDAR-LCB-RM, Watervliet Arsenal, Watervliet, NY 12189.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

This report is reissued to include Figure 7, which was inadvertently omitted.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Closure-Packing System
Hydraulic
Seal
Fatigue Test
Cylinder

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Conventional closure-packing systems used to seal pressure vessel cylinders cause diminished stress at the ends of the cylinders. This end effect is the result of the pressure seal being placed a distance in from the cylinder end. While this is beneficial in most pressure vessel designs, it is inappropriate for use in the testing of cylinders when service conditions place full internal pressure to the cylinder ends and these cylinder ends contain potential fatigue

(CONT'D ON REVERSE)

20. ABSTRACT (CONT'D)

critical features. A closure-packing system has been developed to greatly diminish the end effect. The end effects have been measured and the system successfully used in a high pressure hydraulic fatigue test.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83029	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* STUDIES OF REFRACTORY METAL COATINGS FOR ADVANCED GUN BARRELS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) I. Ahmad, J. Barranco, P. Aalto, and J. Cox		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6126.03.H181.211 PRON No. 1A0216131A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE July 1983 13. NUMBER OF PAGES 70
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution limited to US Government Agencies only because of test and evaluation; July 1983. Other requests for this document must be referred to Commander, US Army Armament Research and Development Center, ATTN: Benet Weapons Laboratory, DRSMC-LCB-RP, Watervliet, NY 12189.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

16. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Erosion	Gun Barrels	Gun Steel
Electrodeposition	20 mm Gun	
Tantalum	105 mm Gun	
Refractory Metals	Flinak	
Liners	Pyrotool V	

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report summarizes the results of a study of the application of tantalum coatings in gun barrels and its performance as a protective measure for erosion control. The feasibility of plating liners both for 20 mm M24A1 barrels and 105 mm M68 with 15 mil thick tantalum by electrodeposition from fused eutectic mixture of fluorides of K, Na, and Li has been demonstrated. On test firing tantalum coating in M24A1 barrels out performed the conventional 5 mil thick

(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (Cont'd)

HC chromium coating. The coating, however, showed some swaging. Codeposition of one to five percent chromium was found to predictably increase the hardness of tantalum coating. The formation of β-tantalum phase was discovered during coating 105 mm liners. It is a hard brittle phase. Preliminary test firing of 105 mm M68 with tantalum coated liners have also shown encouraging results.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR- 83030	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* BEHAVIOR OF PRESSURIZED CYLINDERS WITH MULTIPLE INTERNAL CRACKS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. F. Throop and R. Fujczak		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No.6111.02.H60011 PRON: 1A2250041A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE Sept. 1983 13. NUMBER OF PAGES 34
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for Public Release, Distribution Unlimited

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Submitted for publication in Experimental Mechanics Journal

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Fatigue Cracks
Multiple Fatigue Cracks
Thick-Wall Cylinders
Crack Shape
Autofrettage
Strain Measurements
Lame' Strain
Ultrasonics

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Thick-walled cylinders containing more than one internal crack are compared with one containing a single crack. Their crack growth and strain behavior show that one of the cracks becomes dominant and controls the failure. Monitoring the circumferential strain over the dominant crack gives an indication of when failure is imminent.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83031	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* EVIDENCE FOR THE MELT-LUBRICATION OF PROJECTILE BANDS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR*(s)* R. S. Montgomery		8. CONTRACT OR GRANT NUMBER*(s)*
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS NO.6111.02.H600.011 PRON NO.1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE Sept. 1983 13. NUMBER OF PAGES 27
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for Public Release; Distribution Unlimited

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

To be presented at American Society of Lubrication Engineers Meeting, Chicago, 7-10 May 1984, and to be published in the ASLE Transactions.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Melt-lubrication
Lubrication
Projectile Lubrication
Rotating Bands

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Despite the long-time acceptance of melt-lubrication of rotating bands by the Army Scientific community, all of the evidence supporting this conclusion has not been collected and, indeed, some has never been published. The melt-lubrication of rotating bands is very important because then sliding is lubricated and friction and wear is determined only by the characteristics of the molten film and the amount of melting at the sliding interface. Melt-
(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (CONT'D)

lubrication results in much less resistance and much less severe wear than would otherwise be the case. Friction, wear and metallographic evidence from examination of recovered projectiles and fired cannon tubes show the melt-lubrication of projectiles sliding on a gun bore. This melt-lubrication is caused by the production of a thin surface film of molten rotating band material. Such a molten surface layer can also be produced on the surface of materials other than copper alloys contacting the bore at high bearing loads.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83032	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* ELECTRICAL TRANSPORT IN LOW RESISTIVITY AMORPHOUS ALLOYS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) L. V. Meisel and P. J. Cote		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS NO.6111.02.H600.011 PRON NO.1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE Sept. 1983 13. NUMBER OF PAGES 33
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for Public Release,Distribution Ullimited

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES Presented at the meeting of American Physical Society, March 1983. Submitted to the Journal, Physical Review.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Electrical Transport
Amorphous Alloys
Diffraction Model
Saturation Effects

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Diffraction model calculations incorporating appropriate scattering matrix elements and phonon ineffectiveness effects (saturation effects) yield results which are consistent with the observed temperature dependence of the electrical resistivity in low resistivity ($\rho < 100\ \mu\Omega cm$) amorphous alloys. In particular, remarkably good quantitative agreement with available detailed resistivity measurements in a-MgZn alloys has been obtained by these methods. The results
(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (CONT'D)

further indicate that saturation effects, which dominate the temperature dependence of the high resistivity amorphous metals, are important even for resistivities as low as 50 μΩcm.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83033	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* CHARACTERIZATION OF CRYSTALLOGRAPHIC STRUCTURE AND INTERNAL STRESS OF CHROMIUM COATINGS PLATED UNDER CURRENT INTERRUPTIONS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) G. P. Capsimalis and E. S. Chen		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No.6111.01.91A0.0 Pron:1A1281501A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE Sept. 1983 13. NUMBER OF PAGES 15
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT *(of this Report)* Approved for Public Release, Distribution Unlimited		
17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*		
18. SUPPLEMENTARY NOTES Presented at the Tri-service Symposium on Gun Tube Wear and Erosion, 25-28 Oct. 1982, Dover, New Jersey and published in the Proceedings.		
19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)* Chromium Plating Current Interruptions Microstructure Hardness Crystal Structure Texture Stress Microcrack Morphology		
20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)* The effect of interrupted current (IC) plating on the visual crack morphology, crystallography, and residual stresses of electrodeposited chromium has been investigated. Varying the process parameters such as the on/off plating cycle and current density resulted in changing the crystallographic fiber texture of the deposit from the conventional <111> orientation to a combination of <211>, <111>, and a small fraction of randomly oriented crystallites. Under (CONT'D ON REVERSE)		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (CONT'D)

these plating conditions, it was also found that (1) lower amounts of chromium hydride (CrH_x) occur in the deposit, (2) a large decrease in the microcrack density of the deposit occurs, and (3) the deposits tend to become compressively stressed.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-TR-83034	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: SAMPLE PREPARATION AND EVALUATION OF STEEL SPECIMENS FOR INCLUSION RETENTION AND SUBSEQUENT AUTOMATED ASSESSMENT	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Theresa V. Brassard	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Center, Benet Weapons Laboratory, DRSMC-LCB-TL, Watervliet, NY 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Center, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801	12. REPORT DATE: October 1983
	13. NUMBER OF PAGES: 9
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

This report has been approved and accepted by ASTM as a standard practice for preparing and evaluating specimens for automatic inclusion assessment of steel. It is published in the Annual Book of ASTM Standards, Part 11.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Standard Practice
Metallographic Preparation
Steel
Inclusions
Interference Microscopy

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A recommended practice for preparation and evaluation of steel specimens for automatic inclusion assessment was developed. The polishing procedure involved the use of diamond abrasives on rotating paper laps. This technique preserved the true morphology of the non-metallic inclusions. Evaluation of a properly prepared sample was accomplished using the sensitive tint condition of Differential Interference Contrast Microscopy.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-MR-83035	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: MICROSTRUCTURAL ANALYSIS OF A RAPIDLY FIRED FIVE-INCH NAVY GUN TUBE	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): T. Brassard and J. F. Throop	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research and Development Center, Benet Weapons Laboratory, DRSMC-LCB-TL, Watervliet, NY 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 612105.H840011, PRON No. 1A123695IA1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research and Development Center, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801	12. REPORT DATE: October 1983
	13. NUMBER OF PAGES: 16
14. MONITORING AGENCY NAME & ADDRESS *(If different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution limited to US Government Agencies only because of test and evaluation; October 1983. Other requests for this document must be referred to Commander, US Army Armament Research and Development Center, ATTN: Benet Weapons Laboratory, DRSMC-LCB-RM, Watervliet, NY 12189.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Metallography
White Layer
Gun Steel
Navy Tube
Erosion

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A metallographic analysis was performed on various sections along the bore surface of a rapidly fired Navy cannon. This rapid firing program produced the most severe thermal environment ever achieved in a medium caliber gun, and thus exceeded the barrel thermal design parameters.

An attempt was made to characterize the heat affected zone or so-called "white layer" which formed on the bore surface of the tube. Identification of the
(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (CONT'D)

microstructures comprising the layers of this thermally altered zone was made by microstructural appearances and resulting microhardness data obtained from the individual layers.

The heat affected zone or "white layer" produced along the bore of the fired Navy tube proved to be similar to that found on the bore of the fired 105 mm M68 cannons. Thickness of these layers varied along the surface of the bore. It was noted that the thickest layers were found on land corners. Chromium plating protected the surface from the excessive heat and the resulting formation of "white layer". However, once cracking began to occur in the chromium plate, the effect of elevated temperature produced during firing was evidenced in the change of microstructure and microhardness in the area directly beneath the crack.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-83036	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* COLD ROTARY FORGING OF A THIN-WALLED RIFLED TUBE		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR*(s)* Boaz Avitzur		8. CONTRACT OR GRANT NUMBER*(s)*
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE October 1983 13. NUMBER OF PAGES 9
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Artillery	Forging (Radial) (Rotary)
Cold Working	Gun Barrels
Forge (Presses)	Steel

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

In Technical Report WVT-TR-75054 on cold rotary forging of rifling into a thin-wall gun tube, it was stated that the yield strength of the forged material increased in the longitudinal direction, while a recoverable loss was observed in the tangential (hoop) direction.

A recently obtained metallographic study of the same material suggests a potential improvement in fatigue life and/or fracture toughness of the material, attained in that earlier work but overlooked at the time.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83037	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* CONCEPT STUDY OF LIGHTWEIGHT LARGE CALIBER WEAPONS FOR MOBILE PROTECTED GUN SYSTEM		5. TYPE OF REPORT & PERIOD COVERED FINAL 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR*(s)* R. H. COLE		8. CONTRACT OR GRANT NUMBER*(s)*
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research and Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, N.Y. 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No: 643635.166.0011 DA Proj.: PRON No.: 1A225E731A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Center Large Caliber Weapon System Laboratory Dover, New Jersey 07801		12. REPORT DATE OCTOBER 1983 13. NUMBER OF PAGES 66
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution limited to US Government Agencies because of Test and Evaluation, October 1983. Other requests for this document must be referred to Commander, US Armament Research and Development Center, ATTN: DRSMC-LCB-DS, Watervliet, N.Y. 12189

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

LIGHTWEIGHT MOBILE GUN SYSTEM
AUTOLOADER CONCEPTS
LIGHTWEIGHT CANNON
GUN MOUNT
LONG RECOIL SYSTEM

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report documents the work done on a program to develop lightweight large caliber autoloaded weapon concepts for use on a Mobile Protected Gun System (MPGS) 15 ton vehicle.

Lightweight gun tubes, breeches and recoil mechanism/mount configurations were developed with the principle of long recoil travel used to minimize recoil forces; 105MM and 120MM weapons were included in the study. Concepts for automatic loading of the weapons were developed with the weapon systems placed within a specified MPGS envelope.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-TR-83038	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: ELASTIC PROPERTIES OF URANIUM - .78 TITANIUM AS A FUNCTION OF PRESSURE TO 1.6 GPa	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): J. Frankel and D. Dandekar* *See Reverse	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Center, Benet Weapons Laboratory, DRSMC-LCB-TL, Watervliet, NY 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 611102H600011, PRON No. 1A1283121A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Center, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801	12. REPORT DATE: October 1983
	13. NUMBER OF PAGES: 10
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented at AIRAPT Conference, Uppsala, Sweden, 15-22 August 1981.
Published in proceedings of the conference.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Uranium
Ultrasonic Velocities
Pressure
Elastic Properties

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The transit time for passage of longitudinal and shear ultrasonic waves through polycrystalline depleted uranium - .78 weight percent titanium (Ti) alloy was determined as a function of pressure in a hydrostatic medium. Specimens of two thicknesses were used in order to eliminate bond-transducer effects from transit time determinations. The longitudinal velocity v_L increases 3.5 percent from one atmosphere to a value of 3.48 km/sec at 1.6 GPa; the shear
(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

7. AUTHORS

D. Dandekar*
U.S. Army Materials and Mechanics Research Center
Watertown, MA 02172

20. ABSTRACT (CONT'D)

velocity v_s increases 5 percent to 2.08 km/sec; the adiabatic bulk modulus B^s increases 8.1 percent to a value of 120 GPa and the shear modulus μ, 9.4 percent to 81 GPa over the same pressure range.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB -MR-83039	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* DETERMINATION OF THE HEAT TREATMENT CHARACTERISTICS OF VARIOUS GUN STEELS BY COMBINED THERMOMAGNETIC AND DIFFERENTIAL THERMAL ANALYSIS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) P. J. Cote		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No.6111.02.H600.011 PRON NO.1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE November 1983 13. NUMBER OF PAGES 11
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution limited to US Government Agencies because of Test and Evaluation, October 1983. Other requests for this document must be referred to Commander, US Armament Research and Development Center, ATTN: DRSMC-LCB-RP, Watervliet, NY 12189.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Magnetic Analysis
Differential Thermal Analysis
Thermogravimetric Analysis
Gun Steel
Quench Transformations

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A study was conducted, in collaboration with the Engineering Support Branch, with the initial goal of determining the suitability of applying a magnetic probe to gun tubes to monitor phase transitions during the heat treat process. Measurements were made in the laboratory using a DTA-TGA apparatus which was modified so that a magnetic force could be applied to a sample in order to monitor its magnetic state during the entire heating and cooling cycle. The

(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (CONT'D)

results clearly demonstrate the potential usefulness of the magnetic probe idea. In addition, we found that the modified DTA-TGA apparatus provides a very sensitive measure of the decomposition of austenite on cooling. Therefore, the study was extended and a wide variety of new details of the quench characteristics of gun steels were obtained. A summary of the results is given in this memorandum.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83040	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* FATIGUE LIFE ANALYSIS AND TENSILE OVERLOAD EFFECTS WITH HIGH STRENGTH STEEL NOTCHED SPECIMENS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. H. Underwood		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.01.91A0.0 PRON No. 1A325D021A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE November 1983 13. NUMBER OF PAGES 18
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented at IX AIRAPT International High Pressure Conference, Albany, NY 27-28 July 1983.
Published in proceedings of the conference.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Fatigue Life
High Strength Steel
Residual Stress
Notched Bend Test
Stress Concentration

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Fatigue crack growth results are presented for a series of tests of high strength steel notched-bending specimens. Eight values of stress concentration factor from 1.5 to 4 were represented in the tests, as well as six forging procedures with yield strengths from about 1000 to 1200 MPa. The cyclic lives of the specimens, ranging from about 2000 to 100,000 cycles, were analyzed, using fatigue stress range calculated from stress concentration factor and from
(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE 99 UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (CONT'D)

a fracture mechanics method. A statistical comparison of the two methods was performed. Photoelastic and finite element methods were used to obtain some of the notch root stresses.

The effects of a single prior tensile overload on fatigue life were considered for many of the tests. There appeared to be a critical ratio (about unity) of cyclic stress range at the notch root relative to yield strength, below which a tensile overload extended fatigue life and above which a tensile overload shortened life.

The effects of prior thermal overload on fatigue life were also investigated in five tests of two specimen geometries. Rapid cooling of the outer diameter of a hollow disk segment of a cylinder extended the fatigue life in subsequent cyclic bending testing of the segment.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83041	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) PREDICTION OF RESIDUAL STRESSES IN AN AUTOFRETTAGED THICK-WALLED CYLINDER		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Peter C. T. Chen		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS NO. 6111.02.H600.011 PRON NO. 1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE November 1983 13. NUMBER OF PAGES 8
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release; Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Presented at the IX AIRAPT Conference on High Pressure in Science and Technology, State University of New York at Albany, 24-29 July 1983.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Autofrettaged Tube
Residual Stress
Bauschinger Effect
Strain-Hardening
Reverse Yielding

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Most of the earlier results for residual stresses are based on the assumption of elastic unloading. In this report, the prediction of residual stresses for the case of reverse yielding including the combined Bauschinger and hardening effect will be reported for an autofrettaged thick-walled cylinder. The Bauschinger effect factor is varying as a function of overstrain. The strain-hardening effect is considered with different parameters used for loading and unloading process. The new results indicate that the influence of the combined Bauschinger and hardening effect on residual stress distribution is significant.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83042	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* MEASUREMENT OF THE EXTENT OF AUTOFRETTAGE IN TUBE SECTIONS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Bruce B. Brown		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 2080.15.6000.0 PRON No. 1A1221B81A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE December 1983 13. NUMBER OF PAGES 13
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution limited to U.S. Government Agencies because of Test and Evaluation, December 1983. Other requests for this document must be referred to: Commander, U.S. Armament Research and Development Center, ATTN: DRSMC-LCB-RM, Watervliet, NY 12189.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Autofrettage
Residual Stress
Fatigue
Tube
Measurement

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The fatigue behavior of a pressurized tube is directly dependent on the residual stresses created by the autofrettage process. A method is presented that unites a convenient measurement technique with a fundamental relationship to yield the degree of autofrettage present in the tube expressed as percent overstrain. This provides a critical datum in the analysis of fatigue data.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-TR-83043	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: FRACTURE BEHAVIOR OF A URANIUM AND A TUNGSTEN ALLOY IN A NOTCHED COMPONENT WITH INERTIA LOADING	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): J. H. Underwood and M. A. Scavullo	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Center, Benet Weapons Laboratory, DRSMC-LCB-TL, Watervliet, NY 12189	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 6126.03.H180.0, PRON No. 1A325B461A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Center, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801	12. REPORT DATE: December 1983
	13. NUMBER OF PAGES: 29
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented at Sixteenth National Symposium on Fracture Mechanics, ASTM, Columbus, Ohio, 15-18 August 1983.
Published in proceedings of the symposium.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Uranium Alloy
Tungsten Alloy
Brittle Fracture
Nondestructive Inspection
Stress Analysis

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A failure of a prototype long rod penetrator is described, including the stress and fracture analyses performed, the materials and service simulation testing performed, and the fracture toughness and nondestructive inspection requirements which were implemented.

Results of a subsequent study are described, which involve the producibility of the long rod penetrator, particularly in relation to the complex fracture toughness testing methods which are required for use with this component.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83044	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) MAGNETIC BEHAVIOR OF PRESSURE QUENCHED CADMIUM SULFIDE CONTAINING CHLORINE		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) P. J. Cote, C. G. Homan, W. C. Moffatt, S. Block, G. P. Piermarini, and R. K. MacCrone (SEE REVERSE SIDE)		8. CONTRACT OR GRANT NUMBER(s) AFOSR Contract No. 79-0126 ONR Contract No. N00014-80-C-0828
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.02.H600.011 PRON No. 1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE November 1983 13. NUMBER OF PAGES 28
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Presented at IX AIRAPT International High Pressure Conference, Albany, NY, 26 July 1983.
Submitted to the journal, Physical Review.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

$CdS_{2x}Cl_{2-x}$
Pressure Quenched
Diamagnetism
Paramagnetism
Superconductivity

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Pressure quenched cadmium sulfide (CdS) containing chlorine (Cl) has been shown previously to exhibit both very large diamagnetism and paramagnetism. The diamagnetism observed at 77K approached Meissner proportion and suggested superconducting like behavior in this material. The effect is known to depend sensitively on the Cl content of the starting material. This report describes the results of a survey of the magnetic behavior of pressure quenched samples
(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

7. AUTHOR(S) (CONT'D)

S. Block and G. P. Piermarini
National Bureau of Standards
Washington, D.C.

R. K. MacCrone
Rensselaer Polytechnic Institute
Troy, NY

20. ABSTRACT (CONT'D)

prepared from CdS systematically doped with increasing amounts of Cl.

The Cl doped material was prepared in a variety of ways: from mixtures of CdS and $CdCl_2$, by precipitation from aqueous solution, and by acid doping. The differently doped starting materials were analyzed for Cl and other impurities before being pressure quenched. The magnetic susceptibilities were subsequently measured.

The results of the survey indicate that the concentration of Cl required to produce specimens with anomalously large magnetism is 0.75 ± 0.10 weight percent. The technique for the preparation of such material is described.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83045	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* MECHANICAL PROPERTIES OF SILICONE RUBBER IN A CLOSED VOLUME		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) G. P. O'Hara		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 2080.15.6000.0 PRON No. 1A1221B81A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE December 1983 13. NUMBER OF PAGES 14
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Rubber	Experiment
Modulus	Elastomer
Silicone	Pressure

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report covers an experiment to measure the mechanical properties of four samples of RTV silicone rubber. The test was conducted under conditions of small strains and an elevated hydrostatic pressure component of stress (0 - 4000 psi). The results gave a Young's modulus in the range of 13,000 to 21,000 and a Poisson's ratio range of 0.48 to 0.49. The Young's modulus values were much higher than the usual tensile values; however, a calculation of bulk modulus gave values which were within the accepted range.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-83046	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* MANUFACTURE OF SPLIT RING BREECH SEALS		5. TYPE OF REPORT & PERIOD COVERED Final Technical Report Jan 79 - Sep 81 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Rocco S. DeMeo		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3297.06.7730 PRON No. 1A9241381A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE December 1983 13. NUMBER OF PAGES 13
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Originally submitted as an MM&T project to the U.S. Army Armament Materiel Readiness Command in September 1981.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Split Ring Breech Seal
Hydraulic Kinking Machine
Splitting the Ring
Polishing Split Surfaces

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

An engineering survey relative to the problems associated with split ring manufacturing was undertaken. The results of this effort are as follows:

1. Kinking: A hydraulically operated kinking machine has been built in-house. Initial testing is very promising. Modification and refinements to this unit are continuing.

(CONT'D ON REVERSE)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

20. ABSTRACT (CONT'D)

2. Splitting the Ring: The feasibility of splitting the ring using an electrical discharge machine "EDM" was investigated. A service contract for EDM cutting employing a traveling wire electrode was awarded. This method proved unsatisfactory for production application. A specification for an automated abrasive saw has been prepared. This machine will have power clamping, adjustable cutting feeds, constant surface feet per minute "SFM" wheel control, wheel guides for stability and self-contained coolant system.

3. Polishing Split Surface: The engineering study failed in locating an adaptable state of the art polishing machine that would meet the rigid requirements of our components. In order to improve on our present method of polishing, an in-house effort has been undertaken. Two wet belt sanders have been purchased and the modification for our application has begun.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83047	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* FINITE ELEMENT RESULTS OF PRESSURIZED THICK TUBES BASED ON TWO ELASTIC-PLASTIC MATERIAL MODELS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) P. C. T. Chen and G. P. O'Hara		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.02.H600.011 PRON No. 1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE December 1983 13. NUMBER OF PAGES 20
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for Public Release; Distribution Unlimited

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented at the First Army Conference on Applied Mathematics and Computing at George Washington University, Washington, DC, 9-11 May 1983.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Thick Tube	Isotropic Hardening
Elastic-Plastic	Kinematic Hardening
Finite Element Method	ADINA Code

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The loading and unloading problems in thick tubes subjected to uniform internal pressure have been analyzed with the ADINA finite element code. The elastic-plastic materials are modeled by two strain-hardening rules - isotropic and kinematic. The von Mises yield condition, the associated flow theory, and a multi-linear stress-strain curve are used in both material models. The numerical results of the stresses and displacements for thick tubes with different wall ratios are obtained as functions of loading history. A comparison of numerical results based on two material models is made.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-83048	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* EXPLICIT FORMULAS FOR C^n PIECEWISE HERMITE BASIS FUNCTIONS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Royce W. Soanes, Jr.		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.02.H600.011 PRON No. 1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801		12. REPORT DATE December 1983 13. NUMBER OF PAGES 8
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented at First Army Conference on Applied Mathematics and Computing, George Washington University, Washington, D.C., 9-11 May 1983.
Published in proceedings of the conference.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Hermite	Finite Support
Piecewise Defined	Finite Elements
Basis Functions	Splines

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Completely factored forms of the piecewise Hermite basis functions are derived. All necessary coefficients for any level of smoothness are shown to reside conveniently in Pascal's triangle.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

TECHNICAL REPORT INTERNAL DISTRIBUTION LIST

	NO. OF COPIES
CHIEF, DEVELOPMENT ENGINEERING BRANCH	
ATTN: DRSMC-LCB-D	1
-DP	1
-DR	1
-DS (SYSTEMS)	1
-DS (ICAS GROUP)	1
-DC	1
CHIEF, ENGINEERING SUPPORT BRANCH	
ATTN: DRSMC-LCB-S	1
-SE	1
CHIEF, RESEARCH BRANCH	
ATTN: DRSMC-LCB-R	2
-R (ELLEN FOGARTY)	1
-RA	1
-RM	2
-RP	1
-RT	1
TECHNICAL LIBRARY ATTN: DRSMC-LCB-TL	5
TECHNICAL PUBLICATIONS & EDITING UNIT ATTN: DRSMC-LCB-TL	2
DIRECTOR, OPERATIONS DIRECTORATE	1
DIRECTOR, PROCUREMENT DIRECTORATE	1
DIRECTOR, PRODUCT ASSURANCE DIRECTORATE	1

NOTE: PLEASE NOTIFY DIRECTOR, BENET WEAPONS LABORATORY, ATTN: DRSMC-LCB-TL, OF ANY ADDRESS CHANGES.

TECHNICAL REPORT EXTERNAL DISTRIBUTION LIST

	NO. OF COPIES
ASST SEC OF THE ARMY RESEARCH & DEVELOPMENT ATTN: DEP FOR SCI & TECH THE PENTAGON WASHINGTON, D.C. 20315	1
COMMANDER DEFENSE TECHNICAL INFO CENTER ATTN: DTIC-DDA CAMERON STATION ALEXANDRIA, VA 22314	12
COMMANDER US ARMY MAT DEV & READ COMD ATTN: DRCDE-SG 5001 EISENHOWER AVE ALEXANDRIA, VA 22333	1
COMMANDER ARMAMENT RES & DEV CTR US ARMY AMCCOM ATTN: DRSMC-LC(D)	1
DRSMC-LCE(D)	1
DRSMC-LCM(D) (BLDG 321)	1
DRSMC-LCS(D)	1
DRSMC-LCU(D)	1
DRSMC-LCW(D)	1
DRSMC-SCM-O (PLASTICS TECH EVAL CTR, BLDG. 351N)	1
DRSMC-TSS(D) (STINFO) DOVER, NJ 07801	2
DIRECTOR BALLISTICS RESEARCH LABORATORY ARMAMENT RESEARCH & DEV CTR US ARMY AMCCOM ATTN: DRSMC-TSB-S (STINFO) ABERDEEN PROVING GROUND, MD 21005	1
MATERIEL SYSTEMS ANALYSIS ACTV ATTN: DRSXY-MP ABERDEEN PROVING GROUND, MD 21005	1
COMMANDER US ARMY AMCCOM ATTN: DRSMC-LEP-L(R) ROCK ISLAND, IL 61299	1
COMMANDER ROCK ISLAND ARSENAL ATTN: SMCRI-ENM (MAT SCI DIV) ROCK ISLAND, IL 61299	1
DIRECTOR US ARMY INDUSTRIAL BASE ENG ACTV ATTN: DRXIB-M ROCK ISLAND, IL 61299	1
COMMANDER US ARMY TANK-AUTMV R&D COMD ATTN: TECH LIB - DRSTA-TSL WARREN, MI 48090	1
COMMANDER US ARMY TANK-AUTMV COMD ATTN: DRSTA-RC WARREN, MI 48090	1
COMMANDER US MILITARY ACADEMY ATTN: CHMN, MECH ENGR DEPT WEST POINT, NY 10996	1
US ARMY MISSILE COMD REDSTONE SCIENTIFIC INFO CTR ATTN: DOCUMENTS SECT, BLDG. 4484 REDSTONE ARSENAL, AL 35898	2
COMMANDER US ARMY FGN SCIENCE & TECH CTR ATTN: DRXST-SD 220 7TH STREET, N.E. CHARLOTTESVILLE, VA 22901	1

NOTE: PLEASE NOTIFY COMMANDER, ARMAMENT RESEARCH AND DEVELOPMENT CENTER, US ARMY AMCCOM, ATTN: BENET WEAPONS LABORATORY, DRSMC-LCB-TL, WATERVLIET, NY 12189, OF ANY ADDRESS CHANGES.

TECHNICAL REPORT EXTERNAL DISTRIBUTION LIST (CONT'D)

	NO. OF COPIES
COMMANDER US ARMY MATERIALS & MECHANICS RESEARCH CENTER ATTN: TECH LIB - DRXMR-PL WATERTOWN, MA 01272	2
COMMANDER US ARMY RESEARCH OFFICE ATTN: CHIEF, IPO P.O. BOX 12211 RESEARCH TRIANGLE PARK, NC 27709	1
COMMANDER US ARMY HARRY DIAMOND LAB ATTN: TECH LIB 2800 POWDER MILL ROAD ADELPHIA, MD 20783	1
COMMANDER NAVAL SURFACE WEAPONS CTR ATTN: TECHNICAL LIBRARY CODE X212 DAHLGREN, VA 22448	1

	NO. OF COPIES
DIRECTOR US NAVAL RESEARCH LAB ATTN: DIR, MECH DIV CODE 26-27, (DOC LIB) WASHINGTON, D.C. 20375	1 1
COMMANDER AIR FORCE ARMAMENT LABORATORY ATTN: AFATL/DLJ AFATL/DLJG EGLIN AFB, FL 32542	1 1
METALS & CERAMICS INFO CTR BATTELLE COLUMBUS LAB 505 KING AVENUE COLUMBUS, OH 43201	1

NOTE: PLEASE NOTIFY COMMANDER, ARMAMENT RESEARCH AND DEVELOPMENT CENTER, US ARMY AMCCOM, ATTN: BENET WEAPONS LABORATORY, DRSMC-LCB-TL, WATERVLIET, NY 12189, OF ANY ADDRESS CHANGES.